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ABSTRACT

Volume 3 of the report describes the Management Information System (MIS) for monitoring instructional programs developed for the New York State Education Department. The background of the system is discussed with regard to: the specially developed Planning-Programing-Evaluation processes, characterized by: operational as opposed to philosophical objectives, strict budgetary considerations, effectiveness measures, resource allocation plans, and action-oriented feedback; the monitoring system based on a continual vigilance of ongoing activity; and an experimental monitoring system, the Instructional Support System (ISS), developed for the elementary mathematics program in the Patchogue-Medford (New York) school system. Also covered are the seven characteristics of an MIS: an educational program geared to developing a comprehensive occupational program of wide suitability and availability; an educational tree illustrating the subunits of the general program; objectives, determined primarily by the program content and the problems encountered in managing a particular program; modules, and the adaptability of these smaller instructional units in the traditional course; measurements, and the superior suitability of criterion-referenced tests over norm-referenced tests; system design, especially regarding the need for computer assistance; and management, especially in the diagnosis and feedback functions. (JR)

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MONITORING SYSTEM
FOR
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Volume III

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I. BACKGROUND

A. Planning Programming Evaluation (PPE)

During the past several years Riverside Research Institute (RRI) has developed a series of processes called Planning-Programming-Evaluation (PPE) under contract(s) with the State Education Department (SED). PPE can be traced to the Planning-Programming-Budgeting (PPB) Systems which were initially introduced in the Department of Defense, and subsequently extended to other federal and state agencies to improve the management of government programs. Whereas PPB assumes that a classical hierarchical organization exists with appropriate Management Information Systems (MIS) incorporated at the lowest levels of the structure, PPE does not make this assumption. In fact, the design of such a MIS for monitoring instructional programs is the focus of the present effort. Since the conceptual model designed for monitoring instructional programs is a PPE subsystem, a brief overview of five essential PPE concepts will be presented.

1. Operationalized objectives

The PPE System does not accept broad, philosophical program objectives. It requires the consideration of alternative objectives, with continual awareness of the realities of limited resources. Upon reaching general consensus, the

accepted program objectives are subjected to a refinement process directed toward the attainment of a level of specificity which will permit an analytical evaluation of progress. This process involves listing alternative procedures which could be employed to determine the degree to which the objectives have been met. The selected procedures (or operations) represent the operational definition of the program objectives, and are referred to as "operationalized objectives". Therefore, as opposed to setting a general objective such as: "Students should show improvement in elementary language arts", one might establish an operationalized objective such as: "____students will be able to write effective English as demonstrated by performance on ___ tasks (or tests)". The learning time and evaluation period would also be specified, as well as any methods of comparison (e.g., improve ___ amount in comparison to whom or what). The statement of objectives in operational terms outlines the indicators to be used for program effectiveness, and, by doing so requires the further consideration and explication of concrete goals.

2. Objectives-activity-budget linkage

It is not unusual to find management systems wherein objectives are established in isolation, without regard to budgetary concerns. Goals are often divorced from the realities

of operations. In the PPE System, however, objectives are closely linked with plans for achieving the objectives. The PPE "program structure" identifies the significant programs within the system. Objectives are specified for each program. Activities and their corresponding costs are associated with the program objectives. The program structure includes further subdivisions to subprograms, sub- subprograms, etc. Each level requires a more concrete identification of objectives, operations and costs.

This linkage of objectives, activities and budgets through a program structure allows one to pinpoint allocated resources in relation to program objectives. It facilitates comparisons of alternative methods and provides an effective management tool.

3. Effectiveness measures

The program structure informs organizational members of the objectives which they are expected to achieve. It also provides information on the means of achieving them and the resources available. Perhaps of greater import to the individual members, the structure specifies the manner in which progress will be measured. The PPE System focuses significant attention on the measurement system. This emphasis is well justified in view of the usual weight that evaluation bears

upon the motivational substructure within organizations. Apart from such concerns, however, PPE leans heavily upon the measurement systems as a basis for self-corrective decisions during the course of program implementation.

As previously noted, part of the process of establishing objectives requires the selection of procedures to be used to determine the degree to which the objectives have been met (i.e., "operationalizing the objectives;" see I.A.1.). Operationalized objectives provide a basic source for indicators of program effectiveness. These indicators can be applied at various points in time (e.g., mid-program, terminal point, etc.) to evaluate effectiveness. Yet, a dynamic management system requires continual measurement of progress with related corrective mechanisms available for application at the earliest point in time. For a manager to steer such a dynamic system, a management information system must be provided which will yield reliable, valid, and timely information. Of equal importance, the information must be closely tied to corrective actions which exist within the manager's repertoire. Information without action-potential is expensive, inefficient--and frustrating. A defective thermostat which only registers the temperature merely tells you what you don't have to be told--if you are cold. A PPE measurement system will not only

diagnose progress, it will also uncover problems; and it will prescribe appropriate actions to adjust an ongoing program. As noted, the corrective actions must be cast within the bounds of resources available to the manager. Figure 1 illustrates this measurement system in contrast to the usual system.

4. Resource allocation plans

In order to effectively manage a program with established objectives, one must develop a detailed plan wherein resources are allocated to the various components of the program. Whereas, line-item budgeting is oriented toward relating costs to resources, the PPE System focuses upon costing programs. Beginning with program objectives, the alternative means of accomplishing these objectives are considered. This comparison of options is essentially the core process involved in developing resource allocation plans.

Resources include all assets. However, the relative dollar value of such fixed assets as physical plant facility should not be the primary basis for determining degree of emphasis in planning. Variable assets, especially manpower, should be central in view of the annual budget portion occupied.

Resource allocation plans are developed with the aim of utilizing one's assets in the most cost-effective

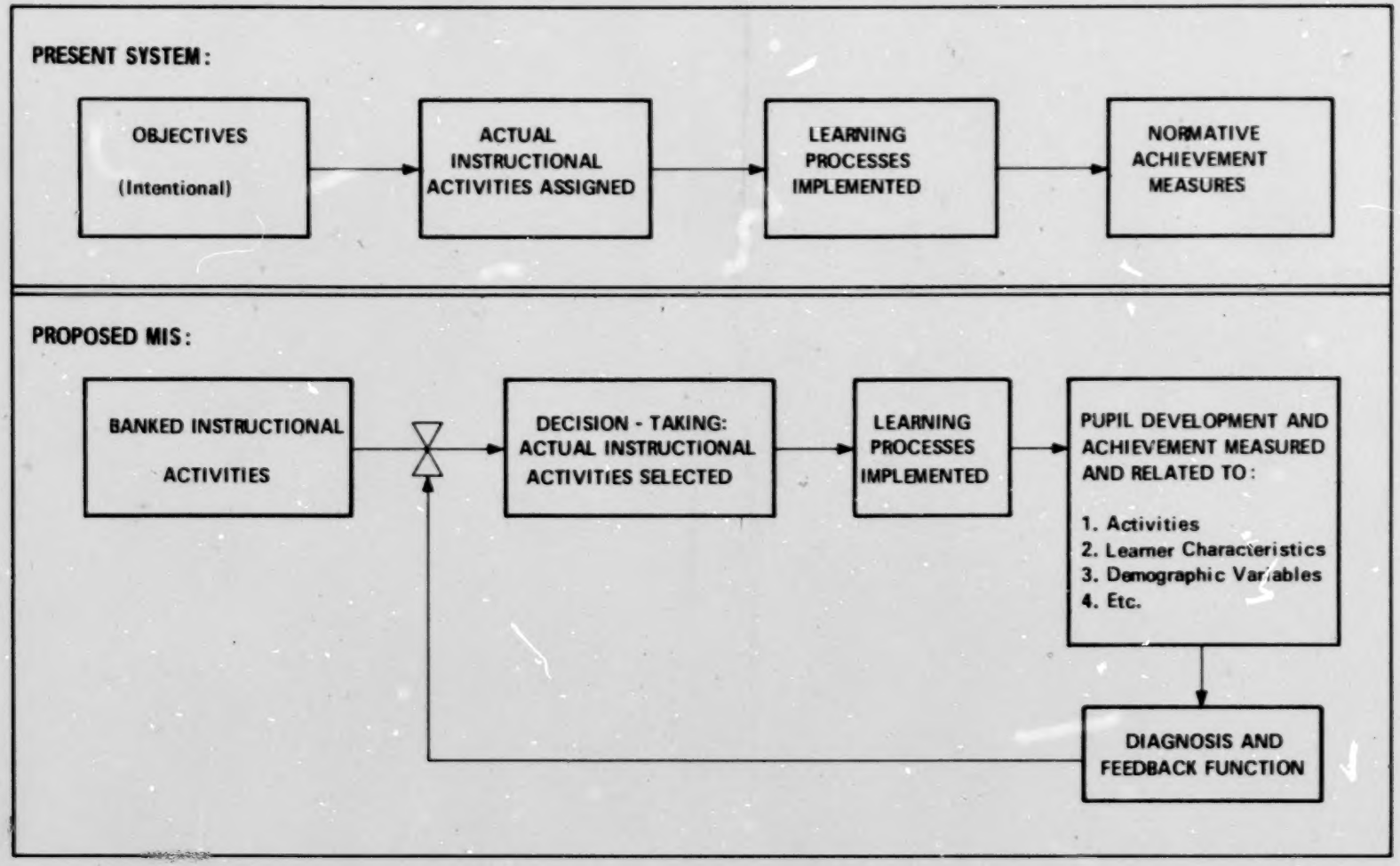

FIG. 1. COMPARISON OF PRESENT TO PROPOSED SYSTEM

method to achieve program goals. They are appropriate at all levels in a program (e.g., state, regional, local, building, classroom); their specificity will vary with levels. At the higher and more general levels, PPE Systems permit more realistic financial planning. The program structure with definable units allows one to more accurately predetermine costs than was previously possible using line-item budgeting and retrieval accounting procedures. At the more detailed levels, PPE Systems require resource allocation plans which identify the student and teacher types; class and faculty organizational structure and size; instructional materials; physical resources and equipment; space; and other variables. Alternatives available include various class groupings; team-teaching models; master teachers; etc. Within a classroom, teachers are concerned with the optimal utilization of their time. Instructional methods and materials, as well as class groupings, can significantly influence the effective use of this major personnel cost.

5. Action-oriented feedback

In discussing effectiveness measures, it was pointed out that information without action-potential is of little value. Figure 1 showed the PPE feedback function affecting the instructional activities. The same measurement system can

be employed to assess and prescribe the optimal allocation of resources within an ongoing program. By evaluating the results of having allocated resources and having undertaken a unit of instruction, one can determine the degree to which objectives were achieved. Consistent with a dynamic management system, one can diagnose deficiencies and prescribe appropriate adjustments if necessary.

Thus the PPE System consists of two feedback loops, one affecting resource allocations, the other affecting instructional activities. (See Fig. 2). From among the array of alternative methods of allocating resources, one must actually take action (i.e., "Decision-taking;" see Figure 2). In a similar fashion, one must also select actual instructional activities. As a result of these decisions, the learning sequence is structured. Finally, student performance is measured and related to resources, activities, etc. In contrast to the traditional use of such measures, however, an action-oriented MIS interprets the information for diagnostic purposes and feeds it back to the ongoing program. (See "Diagnosis and Feedback Function", Fig. 2). Thus the loop between performance and action is closed.

In addition to yielding managerial information for the current operational program, the MIS can also provide

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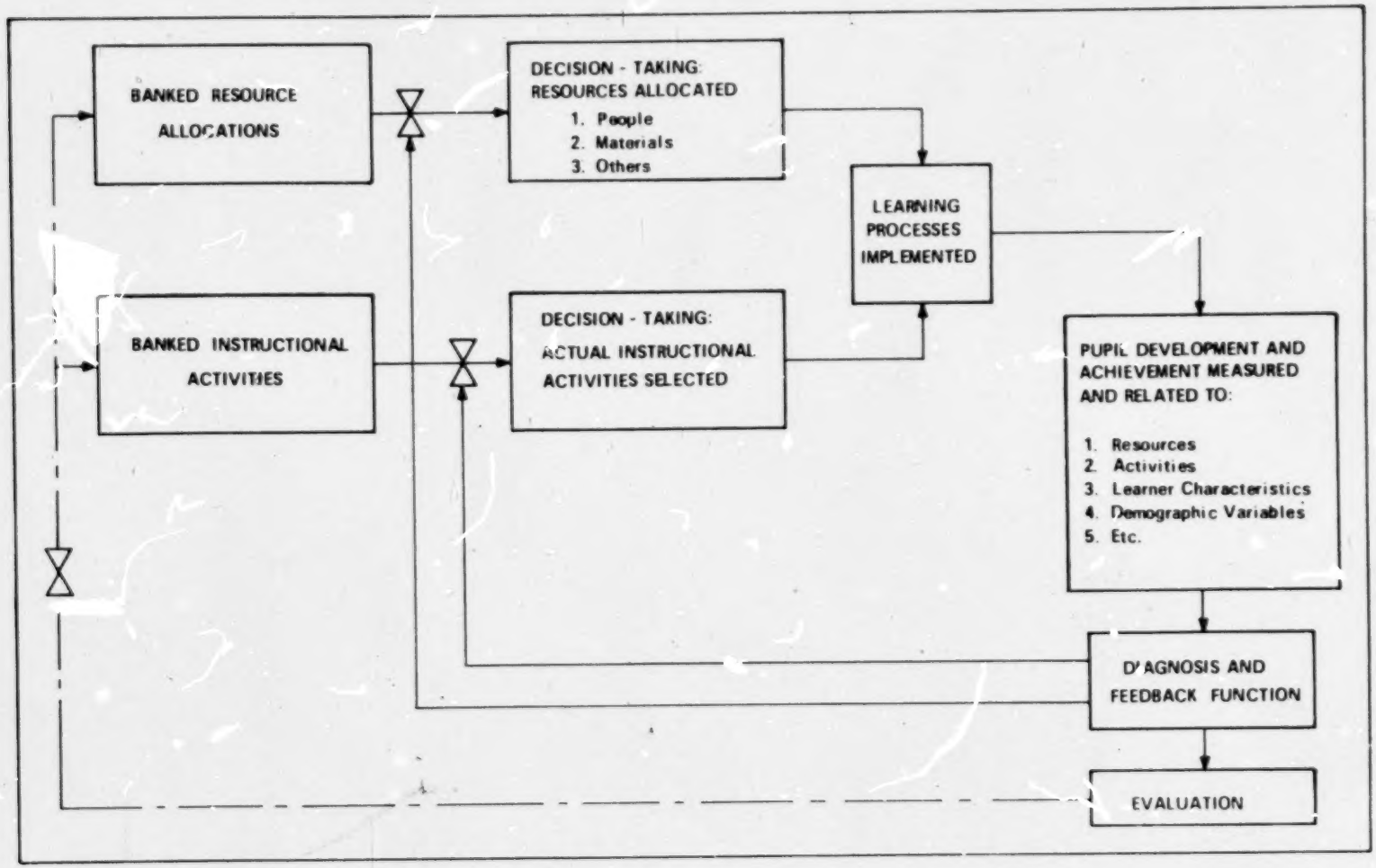

FIG. 2. FUNCTIONAL FLOW CHART OF PROPOSED MANAGEMENT INFORMATION SYSTEM FOR LEARNING

inputs for an evaluation system. Such systems are often designed to measure performance in terms of program effectiveness. Thus MIS data can be reinterpreted to yield evaluation information permitting feedback, on a longer term basis, to banked resources and instructional activities (see Figure 2).

B. Monitoring

Following the planning stage, a program should be implemented in conjunction with a monitoring system which is capable of: assessing whether the implementation is in accord with the original design; measuring the degree to which it is meeting its objectives; providing the management necessary to detect problems and effect operational adjustments.

The two feedback loops discussed in the previous section can be actualized at the local level through a program monitor or manager. Information provided from the measurement program can serve as a primary source for a management information system which enables the monitor to make decisions regarding necessary adjustments in the instructional program.

The key concept underlying a monitoring system is continual vigilance of ongoing activity. As compared with an evaluation system, monitoring involves tracking:

1. Student performance
2. Instructional activities

3. Resources

(a) People

(b) Materials

This continuous check on program elements, which is designed to ensure measured progress toward objectives, differs from evaluation systems which are intended to provide assessment data at a higher management level. Evaluation systems frequently assess performance, not only in terms of local objectives, but also focus on external goals. In addition, they often depend upon norm-referenced measures (e.g., typical standardized achievement tests). Even when they depart from such measures, they tend to use comparative base for evaluation. For example, one might tabulate the number of education-related jobs received by the graduates of a particular program. By collecting similar data throughout the state, a data base is assembled which permits the evaluation of programs in relation to statewide performance. There is no doubt, evaluation systems serve critical functions, but functions which differ from those served by monitoring systems. However, the data garnered from a monitoring program can provide input for an evaluation system. Even though a monitoring program will rely heavily upon criterion-referenced

measures,* which require an absolute as opposed to a comparative basis for evaluation, these data can be reinterpreted in a norm-referenced manner. For instance, a monitoring system could determine the number of students who mastered a specified set of instructional objectives within a unit of time through the use of identified resources. For monitoring purposes, one might relate this information, which details what actually occurred, to the planned or intended performance. Any discrepancies would be identified and corrective actions would be taken. Yet, this same information could provide a valuable input to an evaluation system designed to make periodic assessments of the performance of many similar programs.

C. Instructional Support System (ISS)

In 1969, the Patchogue-Medford (New York) school system, with the assistance of RRI, initiated an experimental monitoring system on a limited basis.

The elementary mathematics program was chosen as the area in which to conduct the first monitoring efforts. This was due to the local concern regarding recent indicators of deficiencies in mathematics achievement. The first step required the development of detailed instructional objectives

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* See Section II E for a further explanation of criterion-referenced measures.

for the mathematics curriculum. Mastery tests and "drop-tests" (i.e., centrally administered tests with content unknown by teachers) were developed and incorporated into the program. A major goal of this limited trial was to determine the utility of alternative reporting modes.

In addition to the many lessons typically learned through an actual operational test in a real district, the project yielded some evidence for the utility of a flexible resource allocation system. On the basis of measurement inputs from the monitoring program, the district noted a discrepancy between the intended and actual performance. This signaled the allocation of supplementary math resources to those buildings identified through the tracking system. Continued vigilance of the program indicated that the limited application of a flexible resource allocation system appeared to yield positive, if modest, benefits to the mathematics program.

RRI's experience at Patchogue and other districts resulted in the tentative conclusion that application of the PPE model to educational programs at the local level appeared feasible, and possibly could yield significant results.

As this field experience was being acquired, RRI began to translate design concepts into an instructional monitoring

system which would be sufficiently elaborated to allow for further experimentation. As these advances were taking place, RRI was benefiting from similar work at SED in Occ. Ed. By keeping abreast of the developments in Occ. Ed., and by gaining field experience in an Occ. Ed. local environment through the test-bed work at Nassau, the initial outline of a work plan for test-bedding a system in Occ. Ed. has been developed. As further progress is made in establishing instructional objectives and in the modularization of instruction in Occ. Ed., the feasibility of actually test-bedding an instructional monitoring system will be explored. Information regarding the relative value of alternative approaches will be furnished as a result of simultaneous work being conducted in the first major attempt to install such a system in a local school district.

In August, 1971, the Guilderland Central School District (GCS) and RRI embarked on the development of an Instructional Support System (ISS) for the elementary mathematics and reading programs.* This three-year project is

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* Since the monitoring program was designed to support the implementation of instructional programs the district coined the term "Instructional Support System" (ISS).

The term was chosen with the aims of emphasizing the teacher-support aspects of the system and minimizing any possibility of repercussions from the negative connotations associated with monitoring and managing concepts. The utility of this term in meeting these aims has not been fully tested.

aimed at the installation of an instructional monitoring program which can be locally supported and transferred to other districts. It represents the first attempt to establish an operational system which is managed by a permanent, full-time program monitor. The experience which will be acquired from this project, as well as the software packages, should reap significant benefits to development of an MIS in Occ. Ed.

II. Characteristics of an MIS

A. An Educational Program

The purpose of occupational education in New York State is described in the Long Range Program Plan in terms of eight broad goals. The first of which is stated as:

> developing a comprehensive occupational education program, suited to individual needs, interests and abilities, and available to persons of all ages and in all areas of the State.

The overall Occ. Ed. program is categorized into seven major content areas: Agriculture, Distribution, Health, Home Economics, Office, Technical, Trade/Industrial. These major content areas are each subdivided into a number of specific terminal programs representing differing specialties. For instance, the health area includes t[illegible]rograms (e.g., dental, laboratory, etc.). Consistent with t[illegible]stated goals, a

comprehensive occupational program has been developed in New York State. It includes several subprograms, which can be further divided into sub-subprograms. In the interest of clarity, however, any defined program, to which one can assign terminal objectives and apply an appropriate, unique title, will be referred to as an educational program. Thus one can reference the broad program of occupational education or a more specific program aimed at the development of specialized laboratory technicians.

All fully developed programs are based upon a plan for the allocation of resources. The program details the relationship between its goals and the means required to achieve the goals. A specific educational program will begin with intended objectives and proposed measures of effectiveness. These will then be related to the activities which will be undertaken as the means by which the objectives are to be met. Whereas program objectives describe intent, program activities specify the way in which the intent is to be fulfilled. The fully documented plans should outline goals and means, and measures of inputs and outputs all of which are set within a specified period of time.

General educational objectives will be common across specific programs. A taxonomy of objectives for broad domains,

such as cognitive, affective, psychomotor, might be appropriately applied. The terminal objectives of a specific educational program can be related to the general taxonomy. By examining such a crosswalk, one might uncover aspects of a program which require further attention, or one might develop insights regarding the relationships among program elements or across different programs. For example, the psychomotor skills required in meeting certain objectives in a radiology program might be quite similar in a nursing program. This could lead to re-clustering portions of the program.

B. An Educational Tree

As noted in the previous section, the general occupational education program can be subdivided into many subunits. A picture of these subdivisions linked with elementary education yields an "educational tree" with a common trunk and many branches (see Figure 3). Although references to the numerous subdivisions, their parts and subcategories can, at times, cause semantic confusions, the picture is worth viewing. It can yield insights and suggest viable alternatives to current organization.

Occ. Ed. has embarked on a project aimed at developing modular instruction. By identifying those objectives which are common to various portions of a total program, they can be

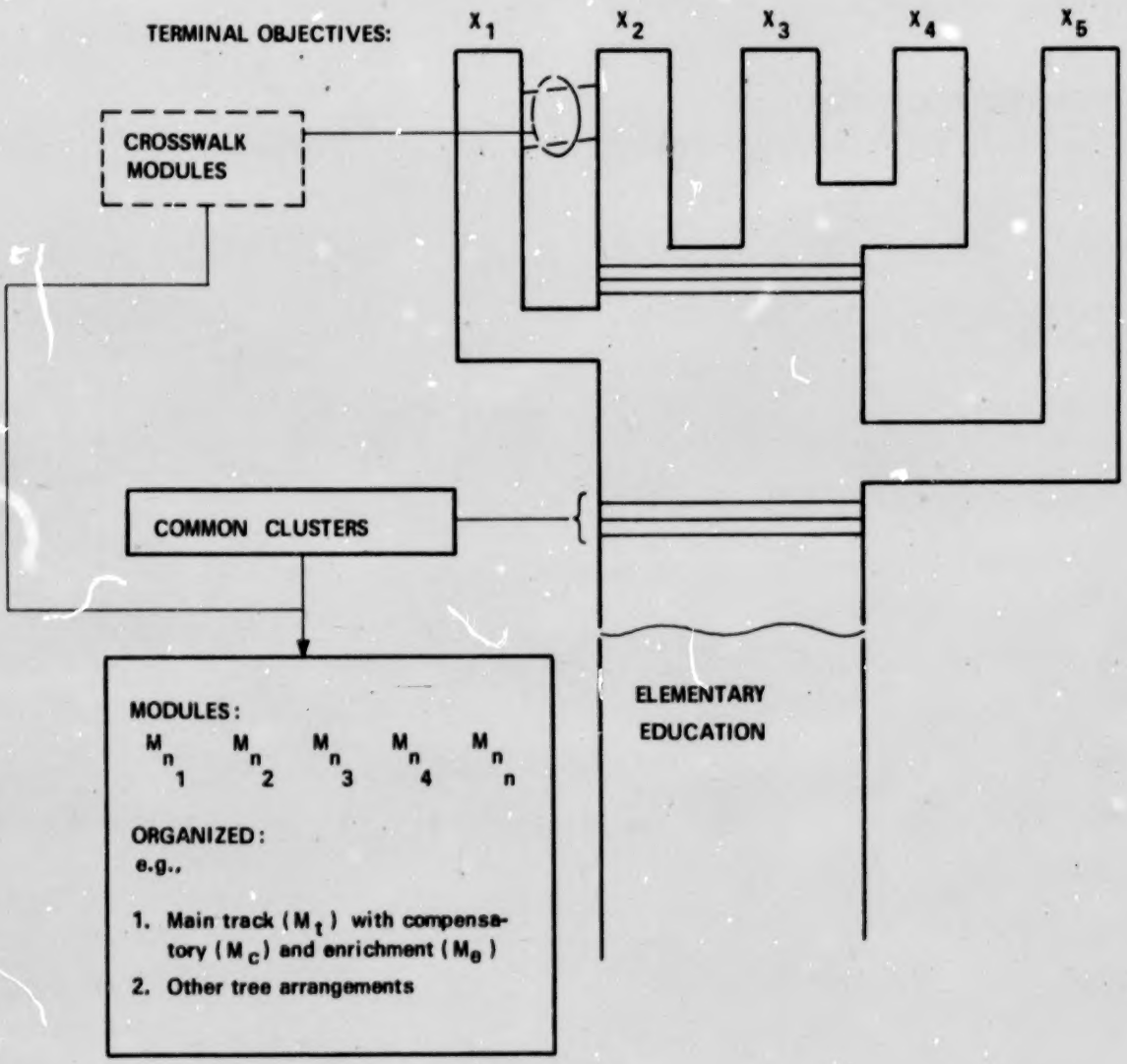

FIG. 3. MODULARIZED INSTRUCTION PLAN FOR OCCUPATIONAL EDUCATION

reorganized into common clusters and presented as an instructional package (see Figure 3). This not only improves efficiency, but also permits greater flexibility for students. Consequently, a student can take a unit of instruction which will be beneficial to his development in several terminal directions. This allows him more time in deciding upon a specialty. It also reduces the amount of re-cycling one must undergo in order to change specialties later.

These common clusters can be organized in various ways. Related objectives could be set into the traditional course or program organization which usually spans a half year or a year. An alternative would be the organization of objectives into instructional units of shorter duration. One common unit has been termed a "module" which typically is a two-week period of instruction on an integrated set of objectives. A combination of the traditional course and the module unit can be achieved by organizing modules into course lengths.

One advantage of the module unit is that it affords the opportunity to build "mini-trees" within a program. A main track sequence of objectives could have module branches for compensatory or enrichment purposes. There are numerous ways of arranging the elements. For instance, as opposed to requiring a transfer student to re-cycle, one could develop

"crosswalk modules" which include just the material not included in the original program (see Figure 3).

C. Objectives

Objectives have been referred to in several previous sections (e.g., IA1, IIA, IIC). It has been noted that objectives should be operationalized so as to permit an analytical evaluation of progress. Yet, as educational programs vary in comprehensiveness, from the overall occupational education program to the laboratory technician program, program objectives will vary in a similar manner. Although vague statements regarding desired outcomes are always to be avoided, the level of specificity and detail required in setting objectives is determined primarily by the program content and the problems encountered in managing the particular program. However, in view of the many terms currently in use, a general review of basic concepts might yield guidelines for setting objectives.

At least ten qualifying terms have been used to define various types of objectives:

1. Educational
2. Program
3. Instructional
4. Terminal

5. Approximations-to-Terminal
6. Course
7. Instrumental
8. Enabling
9. Behavioral
10. Generic

The term "educational objectives" has typically been used to refer to general classification schemes which list various types of learning (e.g., Gagné's learning hierarchy). Most of these classifications were developed with the intent of universal application. For instance, one would expect to find Gagné's "verbal association" learning or "problem-solving" in any educational program. Bloom's taxonomy of educational objectives was developed with a similar intent.

"Program objectives" are similar to the goals established by an administrative unit. They could be set at the SED level, regional or local levels. In contrast to general goals, they are stated in terms of the specific outcomes expected from the program. Using operational definitions, program objectives state the learner behavior which is expected to result as a consequence of the program. Although program objectives focus primarily on the instructional results, they can also be set for non-instructional aspects of the program

such as student welfare, pupil personnel and services. Thus, "instructional objectives" refer to those program objectives which are directly related to instructional activities.

A "terminal objective" is established from an analysis of the specific domain (e.g., knowledge, performance, etc.) that is to be learned by the conclusion of the program. For instance, a concrete terminal objective might be: learners will be able to use appropriate tools in repairing an engine. "Approximations-to-terminal objectives" refer to objectives which are established as short term or intermediate steps to be taken on the path toward the achievement of terminal objectives. They might be set within a time frame (e.g., a "course objective") to allow monitoring of progress. An example might be: learners will be able to use a certain tool to repair a certain problem with a type of engine.

"Instrumental objectives" (or "enabling objectives") are often used to refer to course objectives, too. However, they are sometimes differentiated from approximations-to-terminal objectives in that the student might be required to learn something which aids in the development of the terminal performance, but which in itself is not required to meet the terminal objective. For example, students might be taught a special vocabulary which is useful for later classroom

communication as one works toward the terminal objectives (e.g., phonetic terminology, nomenclatures of engines, etc.).

The term "behavioral objective" has been widely used, with the consequence that various denotations and connotations are presently associated with it. While attempting to refocus attention away from setting objectives in terms of teacher activity (e.g., to demonstrate how to use equipment), many advocates of behavioral objectives stressed the importance of learning outcomes. The question was asked: "What should learners be able to do as a result of teaching?" Programmed instruction led others to advocate that objectives, instruction, and testing all be on the same level. This approach can lead to an enormous catalog of very specific objectives; at its extreme, it would require an objective for every possible test item.

The level at which an objective is stated is also at issue when the term "generic objective" is used. A recently developed reading program at SED has used this term to apply to objectives which are stated in a form that is sufficiently general to permit use at different levels within a program. For example, a generic objective might be: "Given two stories orally, the student says their similarities." The intent of this general statement is to avoid the specificity of the

difficulty level of the stimuli so that the same objective can be used from the very low to the higher grades.

In addition to the ten types of objectives which have been introduced, there are many others. The benefits to be derived from the various terms is not yet clear. Hopefully, an open approach will permit the value of the various typologies, logical distinctions, and terms to be tested in practice. For the present, however, it might be of greater import to limit the vocabulary. This can be done without forgetting the reasons for the coining of the sundry terms. As a first step in this direction, it might be well to focus initially upon the establishment of objectives in a manner which meets the requirements of operational definitions, while using the more neutral terms (i.e., program objectives, terminal objectives, and course objectives).

D. Modules

In the previous discussion of an educational tree (see Section IIB), it was pointed out that instructional activities can be set into clusters which are common to various branches (or specialties) of the tree. These clusters can be organized into the traditional course length, or divided into smaller units referred to as "modules" or can be organized in a manner which combines both units. That is, common activities

can be organized into modules, which are then set into the traditional course. It was noted that an advantage of the module unit is its inherent adaptability, due to size, which permits the use, and encourages the development, of branch-like modules within the usual course. As a result, one would expect to find crosswalk modules to other programs, remedial modules within a program, as well as enrichment modules to aid the advanced student.

An essential aspect of the module concept is the small unit. It has been typically set for a two week interval of time. However, there is nothing sacred about the two week period. Depending upon the needs of a specific program, it could be set for any unit of time. It could even be a variable period, with some modules spanning four weeks and others one week. As long as objectives can be organized into a small manageable unit, with a relatively consistent time period linked to it, and with identifiable beginning and termination points, one can utilize the module concept.

The short interval notion is based upon the need to identify problems at an early stage. In addition, by using a small unit, one can easily develop additional modules for special purposes (e.g., remediation). If a measurement program is integrated into a module system, it will permit

end-of-module testing and the subsequent establishment of decision rules which specify corrective actions should the actual performance be different than the performance expected. The short time interval allows students to be re-cycled through a module or to take a special module without fear of losing pace with others in the program. Decision rules might call for a re-allocation of resources. Teachers or students might be re-grouped.

In addition to these advantages, the module unit is a core element in the development of a management system. When an educational program is rigidly organized into term courses or year-long programs, one has little flexibility, and is, thus, highly constrained in exercising effective management. By organizing a program into manageable units, one is afforded the opportunity to make adjustments during the course of an operational program.

Besides providing a central element for a manageable system, the module unit can also yield the basis for financial planning. By attaching cost data to a module, one can identify the input for a smaller portion of the total program. Output can be easily measured by focusing on the objectives measured within the module. A small unit which can be costed in advance should be amenable to direct transfer to industrial

work programs and other similar programs which are not under the operational control of BOCES or districts.

In designing the content matter to be included in modules, the first step should be Job Family behavioral analysis of the various fields to be served by the overall occupational education program. Detailed job analyses should identify the required skills in each job. After setting objectives, jobs should be organized into skill families. Care should be taken to ensure that objectives are job-relevant.

A plan should be developed for the allocation of all resources which are directed toward the attainment of clearly stated objectives within the given period of time established for the module. Initial decisions regarding the allocation of resources are made by considering all available alternatives. Resources can be categorized in various ways. One might begin by considering the combinations possible within and among the following categories: human time (teacher, paraprofessional, learner), equipment, space, textbooks, consumable materials, and overhead.

In a similar fashion, the actual instructional activities which will be required to meet the objectives, are outlined. A detailed instructional activity might identify: instructional method, teacher-student roles, teacher-student

characteristics, etc. Fully developed modules of instruction will include detailed instructional activities, as well as the specification of objectives, resources, time, and performance measures. The latter will be discussed in the next section.

E. Measures

An integral part of the implementation of an educational program is the establishment of an operational measurement system. Student performance measures are central to the system. The total system, however, should also include data inputs which result from tracking instructional activities and resources. The overall monitoring system should provide sufficient information to permit ongoing managerial adjustments, while at the same time, yielding the data base for measuring the degree to which the program is meeting its objectives.

In developing learner performance measures to be used in a monitoring system, one cannot depend upon the norm-referenced testing model which serves as the basis for most standardized achievement tests. Although the norm-referenced model can be useful for many purposes, it was not developed with the problems of program monitoring or evaluation in mind. Relying heavily upon methods developed to measure abstract psychological constructs, norm-referenced tests are potentially dysfunctional when used in monitoring systems.

Since test specialists are usually governed by the general purpose of developing measures which will identify differences among individuals, they often select test items on the basis of whether they can differentiate among people. The technology is deeply rooted in this philosophy. Item analyses search for discriminability; rules of thumb call for few very easy or very difficult questions. The performance measures which result from these tests often mask both the merit of educational programs and measured progress toward goals.

Most norm-referenced tests assume a compensatory model for the derivation of individual scores. Other things being equal, it assumes that a student who misses all of the questions on engine nomenclature and does well on problem-solving is the same as the student who misses the problem-solving questions and does well on engine nomenclature. Apart from the correctness of the assumption, the usefulness of such summary test data to the user is questionable. The lack of specificity in output diminishes the range of alternative corrective actions available. With a potpourri of stimuli yielding responses summed in a compensatory manner, one simply cannot identify the deficiency nor begin to take corrective action.

Even if the typical norm-referenced test yielded multiple subscores, one would still not be able to determine what

a student had learned, or the actual portion of a content domain which had been mastered. This is a natural consequence of the testing model which is aimed at measuring differences among individuals.

A criterion-referenced test is defined as one that is constructed to yield scores which can be directly interpreted in terms of performance standards. This should not be confused with an achievement test which has a set passing point. To properly construct a criterion-referenced measure one must define a class of tasks which one might expect an individual to successfully complete as a result of instructional activities. The test is deliberately constructed with items which sample the class of tasks. Individual scores relate to the tasks or class of tasks, not to other scores.

Although a criterion-referenced test could look very much like a norm-referenced test, it differs in: purpose, construction, scoring, interpretation, utility. It is not intended to yield individual difference comparisons; it does not follow the same construction pattern (e.g., moderate difficulty levels, high discriminability); the scoring system is not as dependent on the compensatory model (i.e., scores on apples and oranges are not pooled); it is more amenable to the establishment of meaningful passing points and one can

better determine the actual material mastered; it has the potential for far greater utility as a monitoring instrument. In brief, the most significant differentiating characteristics from the typical norm-referenced test is the absolute basis for interpretation as opposed to the comparative basis built into the norm-referenced test.

It is expected that a monitoring system which is based upon criterion-referenced measures will yield improvements in the certification process. The establishment of passing points--a central concern for certification purposes--represents a critical area of neglect by traditional psychometricians. However, the absolute interpretation of data, through criterion-referenced measures, yields information which is closely linked to the actual terminal behavior. As a result, passing points can be set in a manner which directly relates to the behavior sought.

Criterion-referenced measures can be administered to each student at the completion of each module of instruction. This system would yield the means for establishing decision rules regarding the next unit of instruction for each student. It should be noted, however, that for monitoring purposes alone, a sampling procedure could be applied whereby tests would be administered to only a portion of the learners.

By testing at the conclusion of a module, a measure of effectiveness is linked with a manageable unit (i.e., the module). A reporting system can also be established to track the instructional activities undertaken for each module. By testing on instrumental objectives, which are imbedded in instructional activities, one can check on the use of the activities. Resources can also be tracked through a reporting system. Should local constraints hinder the establishment of a reporting system to track human time, gross measures can be derived from the intervals between end-of-module tests. Thus, continual vigilance can be maintained on the program elements. The same information can provide the ingredients for a data base which can be used for longitudinal studies and for input to evaluation systems.

F. System Design

It is not expected that any one procedure for installing a monitoring system will be appropriate for any large number of local programs. However, it is expected that the basic elements will be similar enough both to permit gains from experience and to yield data inputs to a common evaluation system.

Information processing is a major concern in designing the operational system. The system must be designed so as to allow the rapid and orderly storage and retrieval of information.

Although such a system need not be computer-based, it is likely that electronic data processing will eventually be required. The need for computer assistance will become more apparent as the data base permits the application of sophisticated analytical approaches. That is, as monitoring systems become a reality, and when they are closely integrated with ongoing educational programs, data bases will be established which will allow and require the application of advanced mathematical and logical systems capabilities to the delineation and interpretation of alternative decision rules and resource allocation plans.

Even at a primitive stage, significant design decisions must be made. Test development procedures must be established with a concern for test security and the equivalence of measures. The design of test reproduction, ordering, administration, and processing must be accomplished within the constraints and limitations of the current operational system.

Forms must be designed for the instructional activity and resource reporting systems. These, especially, must be developed in close cooperation with the existing management system. In addition, output formats for reports to teachers, learners, parents, and administrators must be designed.

RRI has developed computer software to match the hardware configuration of the Albany BOCES. The system, designed

for the Guilderland School District, included relatively permanent files on district schools, teachers, students, test answer keys, performance criterion levels for instructional objectives. It is capable of receiving answer sheets from over six hundred different tests, as well as reports on instructional activities and allocated resources. The operational system scores the tests, compares performance on each objective with pre-established criterion levels, and generates multiple report forms.

Reports currently display for each teacher, within each school, the performance of students within each module of instruction. Presented next to each student's name are the instructional objectives included in the module together with an indication of whether the student was successful on the respective objectives (i.e., whether the criterion level was reached). It also notes the individual scores on each objective and the related criterion level. In addition the dominant instructional activity used in teaching the objective is linked with each objective for each student. The activities are categorized by instructional method, material resources, and class size.

Although the Guilderland experience has indicated that the implementation of such a monitoring system is possible,

there is no reason to believe that the particular configuration is optimal for all situations. As was previously pointed out, it is not expected that any one design will be appropriate for all local programs. Nevertheless, the basic elements, both conceptual and operational, should be relatively universal.

G. Management

The management of an educational enterprise is no simple task. It is, in fact, one of the most complex and demanding administrative undertakings. Local educational programs are presently managed through the sundry informal organizational structures spread throughout the state, even though consistent formal organizational patterns exist. The central manager, a superintendent, must be responsive to the directions and policies of a board, as well as to the general public, which exercises varying degrees of social and economic influence over the educational program. Whether the superintendent governs a local district or a BOCES, he must also adhere to federal and state requirements. At the operational level, one often finds an assistant superintendent for instruction, who is the typical line manager of local educational programs. However, his authority is diminished by the presence both of subject matter experts (district coordinators, department chairmen, and teachers) and of independent administrators

(principals and supervisors). Another significant force is the existence of the co-equal position--assistant superintendent for business, who monitors the resources.

Once an educational program has been fully developed with the delineation of essential components as previously discussed, a monitoring system can be designed and installed. However, to actually implement the monitoring function, a program manager must be designated to make decisions regarding the changes in elements of the instructional program. Since the central concepts of monitoring include resource allocation and alterations in instructional activities, a role must be established for the execution of these functions.

The data base which grows from the operational system contains the potential for an information overload. Therefore, a crucial aspect of the system is to design methods which will manipulate the information subset so as to produce reports which are meaningful to a manager. Meaningful managerial reports are those which permit operational decisions and actions. Information selection, methodological developments and report designs, all must stem from a thorough analysis of the repertoire of the manager.

An actual educational program is implemented by initially making decisions with regard to the allocation of

resources and the selection of instructional activities. Following the learning sequence, performance measures are related to resources and activities. This information is interpreted for diagnostic purposes and is fed back to the ongoing program. It is here, at the diagnosis and feedback function, where the managerial role is central.

To properly build an effective management information system to assist in this function, one must catalog the diagnoses possible. This should be accomplished in concurrence with a list of corrective actions. The major challenge is to transform the data inputs into an output form which correlates with the possible diagnoses. A related effort must be taken to develop the decision machinery which will permit one to make probalistic judgments as to whether a particular output matches a diagnostic category.

The implementation of corrective actions can occur in various areas and can be accomplished through a variety of managerial styles. Program adjustments could be made in subject matter covered, instructional method, grouping, etc. Alternative resource allocation plans could be set into operation. The corrective action could be taken simply by providing feedback to students. Alternatively, the program manager could interact with teachers. The interactive process

could take various forms.

In summary, the design and implementation of an effective monitoring system requires a thorough analysis of the existing operational system. The technological innovations must be introduced in relation to what exists and to what is possible. A monitoring system cannot operate in a vacuum. When introduced within the adaptation range of an existing system and within the bounds of what is possible, it can offer real benefits to the management of education.